

The new challenges of Innovation: The future of subcontracting facing the threat of the environment

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Abstract- *Globalization of the economy and open borders have companies, including subcontractors, facing a great challenge of competitiveness. Such is the case of Tunisian companies.*

Tunisia has a Mediterranean climate in the North and the East Coast, semi-arid in the interior regions and Saharian in the south. Its closeness to Europe and the cheap manpower are the main assets which made several European companies subcontracted their activities to Tunisian companies.

However, with the evolution of the environment these assets have lost their value facing the intensified competition, notably with the emergence of China that subcontracts very cheaply. Tunisian firms are facing a big challenge in trying to attract and retain a client- donor- henceforth is becoming very demanding. Building on the efforts of R&D is now the key to overcoming these difficulties and establish sustainability.

Through the study of three cases of Tunisian subcontracted industrial enterprises and an abductive approach, our work reveals that, faced with a perceived as unstable environment, companies find it necessary to accentuate their R&D. The latter manifests itself in the co-conception or attempted inventions under development making it possible to offer new benefits.

Keywords- *Environment; R&D effort, Technological Innovations; co- conception.*

1. INTRODUCTION

Loyal to their continued commitment to their ordering clients, the subcontracting companies managed to survive. Today, with the globalization of the economy, competition is becoming fierce, especially with the emergence of China as the first competitor of these companies. In fact, Chinese companies subcontract at the lowest prices. Currently they manage to attract a large number of multinational companies. How then establish sustainability facing this competition?

On the practical level, it must be noted that some Tunisian subcontracted companies succeed to compete and survive by increasing their effort of R&D, which is embodied in different forms of technological innovations. Our research objective in this article is to explain the importance of the R&D effort in subcontracting companies. Our research question that we are asking is: **"What are the explanatory factors for the investment in R&D supplied by industrial subcontracting companies?"**

The approach we have adopted to address this issue is abductive. It includes an hybrid exploratory study based on the technology of «comes and goes» between the empirical field study and analysis of the literature. The empirical field study has been permanent during the execution of the research. Whenever a theme is identified

in the field, we return to the theoretical frameworks associated with it for analysis. The two axes that have structured the theoretical analysis, namely the environment and technological innovation, were built gradually with the progress in the analysis of interviews with experts and case studies in the field.

The article is structured as follows: 1) research methodology, (2) the theoretical framework of the research (3) presentation and discussion of the empirical research results.

2. DESCRIPTION OF THE METHODOLOGY

To attain its purpose, this research was carried out in three phases which are, a theoretical research, interviews with experts and the case study of three cases of Tunisian industrial companies.

2.1. Theoretical research

Within the framework of an abductive approach, it should be noted that theoretical research has been carried out progressively and lasted throughout the research. It will be presented thus the two theoretical axes that guided the latter, which are: the environment and the R&D effort.

2.2. Interviews and contacts with experts

The aim through these interviews is to discuss the explanatory factors for the R&D effort of the subcontracting companies, while putting in evidence the role of the environment. We seek to understand, according to the perception of these experts (managers in Tunisian companies, university professors ...), the economic environment of the Tunisian subcontracted industrial enterprises and its eventual impact on their effort of R&D. The analysis of these interviews and contacts is made from the technique of thematic content analysis.

2.3. Cases studies

2.3.1. The choice of cases

In this step, three cases studies were conducted (Yin, 2002; Rispal Hlady, 2003). This choice is justified by the availability of information and interest with regard to the objective of the research.

Our purpose through the analysis of these cases is to appreciate their effort of R&D and to explain its evolution. Our choice has focused on three cases of Tunisian subcontracted industrial enterprises: CHRISTINE CONFECTION, COFAT and MISFAT (table 1).

Enter-prises	Industry	Activity	Capital TD	Employment
E1	Industries of textiles, clothing and leather	Confection	1 billion dinar	600
E2	Electrical, electronic and appliance industries	Files, insulated cables and cable harnesses	700 000	3200
E3	Mechanical and metallurgical industries	Other general purpose machinery – automobile equipment	3564000	390

Table 1. Description of cases (Source: internal documents)

2.3.2. The analysis strategy

This was performed by the method of cases and that by choosing Tunisian subcontracted industrial enterprises, in which the study has been tested according to the conceptualization within the first part of this article. It is about a research into the content because the purpose is to study a factor in a static manner while attempting to specify the coexistence of a number of elements that define a particular concept (Thiéart et al., 2003). The analysis tools are essentially: the analysis and the interpretation of speech and the analysis of internal papers. In this context, some directive and semi-structured questionnaires were conducted between April 2006 and June 2011 with experts

from business management and innovation as well as members of the R&D structures of the companies surveyed.

The interviews were then subject to a full transcript processed by thematic content analysis.

The interviews have been supplemented by the analysis of internal company documents, which allowed us to collect as much information as necessary to meet our issues and validate our work.

Several internal documents have been used:

- The organization chart of the companies;
- Brochures and documents exhibiting inventions;
- Documents describing the activities of R&D structures.

2.3.3. The formulation of hypothesis

At this stage it is necessary to explain how the conjectures were made. We thus focus on the validity and credibility of the relationship between the built and basic concepts. On the one hand, and while referring to a doctoral research (Alleck, 2010): «The validity of a relationship is directly proportional to the number of cases that confirm the existence» ⁽¹⁾. Rather the credibility refers to the comparison of these links with the literature. Any convergence with literature reinforces the credibility of the hypothesis. And any point of divergence from the theory highlights our contributions (Gavard Perret et al, 2009)

3. THE ANALYSIS OF THE LITERATURE

3.1. Research

According to Niosi (1990): « *Research refers to both basic and applied research. The first is directed exclusively to the creation of new knowledge and takes place especially in universities; the second has as its goal the production of knowledge which will have business opportunities and are carried out especially in companies* » ⁽²⁾. The author proposes two types of definitions to the concept of research, one is general and concerns the universities. The other is linked to the industry and business (Niosi, 1990; Saad et al. 1992). It comes to collect new knowledge inside and outside the company in order to improve knowledge and understandings (Saad et al., 1992; Bellon, 1997). The purpose of any research is the creation of value and that by aiming to provide technical solutions to problems already identified, allowing the company to follow the new technology, to invent and innovate. Thus appears the role of "development."

3.2. Development

Returning to the subject of Niosi (1990), development is defined as « *the application of research results in the creation of product processes or methods of organization that will be commercially viable* » ⁽³⁾. Thus, it is the effort of development which is able to realize human competence as a product or process. It is about a set of steps aimed to

test, develop and prepare a technology to the commercial application (Saad et al., 1992). The more this effort is important, the greater the expected results will bring fresh ideas. In the case of industrial enterprises it is the patent that allows to evaluate the skill level involved in R & D (Meshi, 1997).

3.3. Break the isolation of R&D

As defined, the research and development concepts requires, today, a new definition much more developed emphasizing the importance of the participation of several factors in the search for new ideas (Musso et al, 2007; Yami et Le Roy, 2007). In fact, rather than locked up in their offices or laboratories, engineering researchers are supposed to share opinions with other members of the organization. Working in groups helps develop imagination and create new and original technologies. It is for researchers «to interact with people who are different from them» ⁽⁴⁾ (Musso et al., 2007), including customers, this would be the basis for inventing useful and creative ideas. In the same perspective, Corbel (2009) suggests an organizational structure per project fostering more and more communication between different corporate functions, including the R&D function. Working within a framework per project will help develop communication in order to reduce the risk of failure of innovation. We have just seen, the R&D function is the starting point in an innovation process. It is in this respect, essential for triggering the latter.

3.4. Effort of R&D and technological innovation

In this work we focus on the technological innovation. This latter can be defined as a process which reflects an effort of R&D more or less important and concretized in a product or a process either new or improved (Le Loarne et Blanco, 2009; Corbel, 2009). It differs from the invention, by its utility and its development in the market. Thus we take the following definition as proposed by Zimmern (1973) which states that an innovation is « the resulting of the complex process of turning the invention into a product or a process which can be industrially and commercially used »⁽⁵⁾. Technological innovation can also correspond to some simple improvements in existing technologies. These are the definitions that will be adopted in the context of this work.

The technological innovation has been discussed in the management documents in three forms: incremental, radical and micro-radical (Durand, 1992; Prax et al., 2005; Le Loarne and Blanco, 2009; Corbel, 2009). We refer to these three forms by the concept of innovation intensity.

3.4.1. Incremental innovations

Incremental innovations are the improvements in every day. As regards technological innovations, these improvements concerning the product or its production

process (Corbel, 2009). They affect mainly the price and the quality of supply (Kim et Mauborgne, 2003; Musso et al. 2007; Le Loarne et Blanco, 2009). They reflect, according to Le Loarne et Blanco (2009), changes in the production process of a product, allowing the realization of cost savings.

3.4.2. Radical innovations

The names given to this type of innovation vary according to the authors, whether in the academic or managerial literature. Often known under the name of revolutionary innovation (Guilhon, 1993; Durand et Guerra Vieirra, 1998) or radical (Barreyres, 1980; Ettlie et al., 1984), a radical innovation is distinguished by the rupture it causes in the competitive circle. In this sense, it is capable to cut with consumption habits and create others entirely new (Christensen et Overdof, 2003; Le Loarne et Blanco, 2009). In fact, by the introduction of a new product, the company does not aim the already existing customers in the market. It imposes rather new needs and utilities and increases therefore its communication efforts in order to succeed in convincing these customers to feel the need.

3.4.3. Micro-radical innovation

Early in their development, the radical innovations are classified as micro-radical (Durand, 1992). These latter whilst being « less intense than radical innovations, (...) » are « likely to disturb the competitive dynamics of an industry without thereby jeopardizing the equilibrium involved nor the strategic position of established firms »⁽⁶⁾. It comes to introduce a radical novelty on the market by providing new solutions to some given problems, whose contribution is limited, although its strategic impact was not very significant (Durand, 1992). It is the technological micro-radical innovation which affects the product as well as the manufacturing process. Unlike the radical innovation that causes a disruption of the competitive dynamics, the micro-radical innovation coexists with current technologies. This is also what Prax et al., (2005) highlight by stating that « the new technology causes (...), not only the disappearance of the former but also a redistribution of territories: each redefines its place, and all stabilize ... »⁽⁷⁾. This is the case of the movie theaters and video cassettes for example.

In the same perspective, Le Loarne and Blanco (2009) propose another form of innovation destined for markets that are not targeted by dominant firms. These innovations do not influence in any way the competencies of the competitors, but they do not create a revolution to challenge the old technologies. We believe, in this case, that it is a form of micro-radical rather than radical innovation.

3.5. The environment

Today the environment is characterized by irregularities and contradictions (Hamel, 2001), a rapidity and an accentuation of the competitive intensity which make it more and more difficult to understand and predict (Saïs et Métais, 2003). There exists a rapid technological change, a globalization and a strong competition (Sargis, 2000; Ramirez et Wallin, 2001); an uncertainty and an economic complexity, technological and institutional (Durieux et al., 2000) and a pace of a more and more rapid change (Prahalad et Hamel, 1989).

In summary, we argue that the current environment is characterized by considerable instability and unpredictable events (Mintzberg, 1994). Under these conditions, the accentuation of R&D effort continues to be indispensable in order to ensure the sustainability (Prahalad et Hamel, 1990).

3.6. The relationship between environment and the intensity of innovation

Technological innovation has always been considered as the product of a well-defined strategic behavior (Porter, 1985; Prahalad et Hamel, 1989; Métais, 2002). The radical innovation leads to a reconsideration of the competitive logic that is the very purpose of the strategic intent. This kind of innovation takes the form of a new technology which is the product of a key technological competence (Nord et Tucker, 1987; Métais, 2002; Christensen et Overdof, 2003). Proponents of the strategic intent argue that this logic is advocated in an unstable and highly competitive environment (Prahalad et Hamel, 1990; Métais, 2002). Under these conditions, the company is in front of a strong need for innovation. Its R&D effort is realized in radical innovations. The latter, while being under development, take the form of micro- radical innovations. As to the incremental innovation, it comes down to a series of improvements affecting a product or its production process. it involves regulation in relation to the existing competitive dynamics, which is the same objective of the strategic fit (Porter, 1999). The improvement of the existing is made based on the current competencies of the company (Nord et Tucker, 1987; Métais, 2002; Christensen et Overdof, 2003). These competencies are the product of a single-loop learning (Métais, 2002).

Les proponents of strategic fit assert that this logic is advocated in a relatively stable environment (Métais, 2002). Under these conditions, the company dominates its business sector. Its R&D effort is limited to simple improvements of existing technologies that are incremental innovations.

4. THE EMPIRICAL FIELD: ANALYSIS AND DISCUSSION

The field research is based on two phases: interviews and contacts with experts and case analysis.

4.1. Case by case analysis results

The case by case analysis brings up some specific characteristics of each case treated. In fact, the study of each case has allowed us to note that these companies start to feel the threat of their environment, what pushed them to accentuate their effort of R&D and even to innovate. This effort is realized better in incremental than in micro-radical innovations (appendix 1).

4.1.1. Examples of incremental innovations

Co-conception constitutes one of the forms of incremental innovations concretizing the R&D effort of the companies E1 and E2. In fact, the latter have managed to propose to their client new solutions in order to improve product quality or reduce production costs. For example, E1 did some modification at the collar of a T-Shirt and E2 has proposed a new method of producing beams making it possible to reduce production costs.

4.1.2. Examples of micro- radical innovations

Since its creation, E3 could register only one patent reflecting the existence of key technology competencies. The invention corresponds to a filter containing a multi-filtration system ensuring the passage of the retained by several existing filter papers on a single cartridge, before release for use.

This invention was marketed, it was very useful and had several advantages. Always inspired by the model used by Kim et Mauborgne (2003), these advantages can be summarized as follows



Figure 1: The competitive space created by E 3

a) Radical increase of KFS: the performance, the lifetime

- **The performance** of the filter is ensured by the realization of both improving the retention capacity and efficiency of the realization. If the different solutions available on the market have generated a significant improvement in the retention capacity, they could not affect the efficiency remains dependent on the filter paper used. Thus and relative to its competitors, E3 has managed to achieve this performance by ensuring high retention as well as efficiency. On the one hand improving the filtration efficiency results directly from the use of several filter papers inside of the same cartridge. On the other hand, a significant improvement of the retention capacity has marked this filter. This is due to the multi filtration that has led to an increasing volume of the retained and has generated a better filtration.
- **Increasing the lifetime** of the filter is the second advantage characterizing the E3 filter. Indeed, it is a product having technical specifications allowing it to last longer than the existing filters on the market.

b) Radical decrease of KFS: The renewal of the purchase.

Serial filtration have spawned economic effects that reside in the reduction of the renewal of the purchase, and thanks to the increase in the lifetime of the filter.

c) Adding of KFS: The multi-filtration

E3 filter is distinguished by a filtration system through several filter papers folded and superposed in the right direction of filtration. This allows the passage of fluid to be filtered by each paper one after the other before releasing for use.

d) Deleting of KFS: Advertising

Compared to its competitors, E3 has not launched advertising campaigns in order to present the multi-filtration filter. Its communication policy has been focused on the presentation of samples.

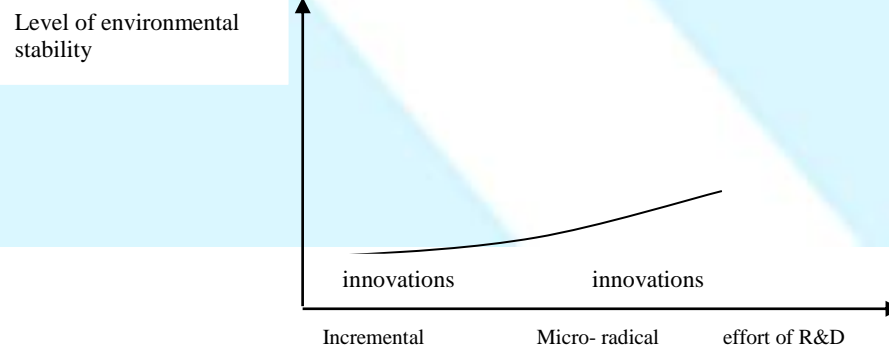
By being marketed, the E3 technology has been creator of values for its users. However, and due to the complexity which characterized the production process, the double filtering filter has been abandoned by the company. This can be explained by the lack of improvement as suggested by Creton (1984) and Bellon (1997), who require a new product in order to adjust it to the market and increase its performance. This is how this innovation has not reached the expected growth and was abandoned.

4.2. A crossed analysis

If the case-by-case analysis has highlighted the environment as an explanatory factor of the importance of investment in R&D, it should in the following synthesize these links. A primary relationship between the environment and the intensity of technological innovation appears from the analysis of the cases. In fact, the threat of the environment puts companies facing a need for innovation. "Innovate or disappear" Such is the reasoning adopted by the subcontractors (E1, E2, E3). This is realized first in the creation, since 2006, of R&D structures within the organizations of E2 and E3. By accentuating the efforts of R&D, companies have managed to provide technological innovations. The case studies of E1 and E2 brings up the co-design as a form of incremental innovation. Companies offer new solutions to their clients allowing to improve the quality or lower product prices. The E3 case is further distinguished by a form of micro-radical innovation, with efforts of circumventing patents constituting projects patented inventions. The environment of this company is characterized by high instability. This relationship between the environment and the R&D effort join party the literature which states that in a relatively stable environment the innovations are incremental (Porter, 1990). When the environment is unstable, companies rather adopt radical innovation (Prahalad et Hamel, 1990).

4.2.1. Proposal of an explanatory diagram and formulation of hypothesis

a. Explanatory diagram



Diag.1. The relationship between environment and investment in R&D: illustration from the cases studied

b. Hypothesis

H. More the environment is unstable, more investment in R&D is important.

A relatively stable environment explains the adoption of incremental innovations. An unstable and highly competitive environment explains the development of projects inventions or the adoption of micro- radical innovations .

Hypothesis	Credibility	Validity
More the environment is unstable, more investment in R&D is important.	C	E1, E2, E3

Table 2: A synthesis of the validity and credibility of hypothesis

With C: Convergence with the literature
D: Deviation from the literature

4.2.2. Back to literature

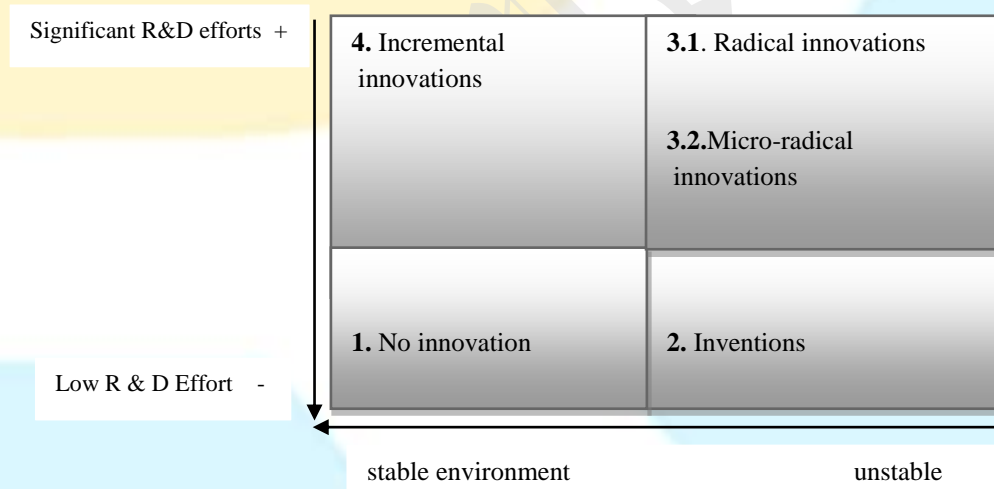
The field study has allowed to explain that investment in R&D of Tunisian companies by the level of stability of the company. As it has given a meaning to the information that have emerged from the observed reality. However, this is not entirely in line with the literature. In fact, some

discrepancies relative to the latter have characterized the empirical results.

Ultimately we can summarize works of literature and positioning the field results compared to these writings thanks to the schematization 2.

- The company made no effort to R&D, skills are described as abundant. Which is expressed by a total absence of technological innovations. This is explained by the stability of its environment.
- The company is active in an unstable environment, yet its R&D effort is described as low. The latter is set out within non -value- creators inventions to the client and the company.
- The company made a major effort in R&D which is realized in radical innovations (3.1). These innovations, while currently under development, are characterized by micro- radical innovations (3.2).
- The company possesses competences and significant investment in R&D. The latter are not yet exploited because the environment is perceived as stable and non-threatening. The effort is limited to incremental innovations.

The contribution of crossed analysis also lies in the possibility of a clustering of cases.



Diag. 2. Confrontation with the literature: synthesis of the relationship between micro-radical innovations and level of environmental stability

4.2.3. A classification of cases according to the importance of the efforts of their R&D

We have adopted within the framework of this work, two grouping methods: the first is drawn on the work of Collins and Poras (1996)⁽⁸⁾ allowing us to consider the intensity of innovation as a criterion for classification. The second method, known as structuralist⁽⁹⁾, advocating comparing cases pair wise and clustering of the most similar cases. Finally, our classification enables us to define two groups named as follows:

- Companies in the process of creativity
- Developing innovative company

a) Companies in the process of creativity

Our previous analysis, has allowed us to find common characteristics of two sub-contractors belonging to our sample which are E1 and E2. These companies were initially simple subcontractors following a set of specific loads. Today they are strengthening their R&D efforts and are classified in the group of companies in the process of

creativity. These two cases are distinguished by the following characteristics:

- The pressure of multinational clients
- The co-conception
- The pressure of multinational clients:

The client is the main factor in the environment of both companies E1 and E2. He represents to multinational corporations that are becoming very demanding facing an environment full of subcontractors. In fact, the historical study of each case, has helped us to make a fundamental conclusion: The customer of yesterday is not any more the one of today. The latter has become more demanding and more difficult to satisfy and to develop client loyalty. In such a context, to be limited to a simple contractor will not allow to gain the confidence of such clients. Thus, to rely on the work of R&D and increase the effort have become vital to meet the new challenge and be able to withstand.

- The co-conception

E1 and E2 give the example of subcontracting companies getting ready for the co-conception. If currently both have managed to be co-designers, the future development of their R&D will classify them among the companies making the design, especially for the E2 case.

b) A company in development

- An important effort of R&D

We have recorded an exceptional effort of R&D characterizing the company E3, which is to circumvent patents by competitors. It is about looking for new solutions far from the region of the latter constituting inventive projects.

- A micro-radical innovation:

The E3 case is characterized by a micro-radical innovation, which has brought KFS without, however, putting into question the pre-established KFS. This type of innovation has allowed the company to develop by improving its strategic position in Tunisia and attracting foreign customers. Indeed if E2 is now beginning to gain the confidence of car dealers, the secret lies in the invention of multi-filtering filter, so created and marketed in the past. This, let us remember, took the form of micro-radical innovation and gave the company a good reputation.

5. CONCLUSION

The detailed cases studies of Tunisian subcontracted industrial enterprises have led us to the conclusion that it is possible for a subcontracted enterprise to innovate. Our research suggests that the way of the sustainability in the market is the accentuation of the R&D effort. The latter is materialized in technologies that take the form of incremental or micro-radical innovations.

This article offers several, theoretical, and managerial contributions. First, we propose a more operational definition of micro-radical innovation, which helps to reinforce the robustness of the conceptual framework. In addition, the explanations that we have presented allow a better understanding of authors' reviews who were till then seem divergent. These contributions help to clarify the conceptual basis of the R&D effort. Furthermore, this research allows emphasizing the consequences of the latter for managers in their companies. Indeed, we encourage subcontracted industrial enterprises, especially in emerging countries, to innovate facing the threat of the environment. In this sense, this study helps to explain the effort of R&D, for both researchers and managers.

A significant limitation of our study stems from the methodology used: of an exploratory nature, it only allows to suggest, not to confirm, explanations. Indeed, even if one of the originalities of our work is based on a qualitative approach combined with three original cases, this methodology rejects generalization.

Much research is therefore still be needed to consolidate the concept of technological innovation and clarify its importance for subcontracted industrial enterprises. They constitute so many exciting prospects for research, useful for both researchers and practitioners confronted with a highly competitive environment.

Notes :

- (1) Alleck, F. (2010), «Une approche par les compétences fondamentales du développement d'une entreprise sur un nouveau marché : cas des compétences technologiques», Thèse pour l'obtention du Doctorat en sciences de gestion de l'université de Caen Basse -Normandie, Mars, p 195.
- (2) Niosi, J. (1990), « L'innovation et la R&D dans les industries de services : le cas de l'ingénierie », in Leclerc M., *Les enjeux économiques et politiques de l'innovation*, Presses de l'université de Quebec, p127.
- (3) Niosi, J. (1990), « L'innovation et la R&D dans les industries de services : le cas de l'ingénierie », in Leclerc M., *Les enjeux économiques et politiques de l'innovation*, Presses de l'université de Quebec, p127.
- (4) Musso, P., Ponthou, L. and Seuillet, E. (2007) *Fabriquer le futur 2 – l'imaginaire au service de l'innovation*, Village Mondial, p 281.
- (5) Zimmern, B. (1972) *De l'invention à l'innovation*, Management- France, p 11.
- (6) Durand, Th. and Guerra-Vieira, S. (1998), « Etalonner l'innovation: métrique d'une innovation annoncée », 7^{ème} conférence de

l'Association Internationale du Management Stratégique (AIMS), 27 - 29 Mai, Louvain La Neuve, p 3.

- (7) Prax, J- Y, Buisson, B. and Silberzahn, Ph. (2005), Objectif : innovation- stratégie pour construire l'entreprise innovante, Dunod, p 56.
- (8) These authors conducted a combination of enterprises, depending on the intensity of strategic vision.
- (9) This méthode was defined by Ederlé (2001).

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Appendix 1. Results of the case by case analysis

E2	E1	E3
<p>Given the requirements of the ordering customer, E2 begins to feel the threat of its environment. Limited, under these conditions, to a simple subcontractor does not guarantee the survival of the company. "Becoming a first hand supplier " by making cable design for cars, now becomes the new vision of the latter, equipped with a set of values summarized in an innovative and creative spirit. This is how a R&D department has been established within the organization in 2006. The company conducts research to learn the cable design. It is said to be prepared for design. At the same time many improvement efforts are made in order to attract and retain clients that are becoming very demanding. These efforts take the form of incremental innovations. The company still tends to be creative and innovative in the future.</p>	<p>The environment of E1 is perceived as relatively stable. The company begins to feel the threat of its ordering customer. Nevertheless, while activating in the textile sector, which is dominated by the big clothing shops, the design is a difficult case. The company increases its efforts in R & D in order to attract and convince its customers. These efforts are summarized in improvements to the models proposed by the customers. These improvements take the form of incremental technological innovations.</p>	<p>At the beginning of its creation the company subcontracted filters to from automotive suppliers. In an environment that is becoming more and more threatening, the company aims to become "the first equipment supplier." In 2006, an R&D department has been established within the organization. By accentuating its</p> <p>R&D efforts one micro-radical innovation was created. Which was later abandoned but has contributed significantly to improve the reputation of the company. Attempts to circumvent competing patents also characterize the technological efforts of the company.</p>